

**FINANCIAL ASSISTANCE
FUNDING OPPORTUNITY ANNOUNCEMENT**



U.S. Department of Energy

Office of Science, Office of Basic Energy Sciences

Basic Research for the Hydrogen Fuel Initiative

Funding Opportunity Number: DE-PS02-06ER06-17

Announcement Type: Initial

CFDA Number: 81.049

ISSUE DATE: April 20, 2006

PREAPPLICATION DUE DATE: July 6, 2006, – Required

APPLICATION DUE DATE: December 12, 2006, 8:00 p.m. Eastern Time

The Application Package (required Forms) will be available on Grants.gov July 15, 2006, for those applicants encouraged to submit a formal application.

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NOTE: NEW REQUIREMENTS FOR GRANTS.GOV

Where to Submit:

Applications must be submitted through Grants.gov to be considered for award.

Registration Requirements:

There are several one-time actions you must complete in order to submit an application through Grants.gov (e.g., obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number, register with the Central Contract Registry (CCR), register with the credential provider, and register with Grants.gov). See www.grants.gov/GetStarted. Use the Grants.gov Organization Registration Checklist at www.grants.gov/assets/OrganizationRegCheck.doc to guide you through the process. Designating an E-Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in the CCR registration process. Applicants, who are not registered with CCR and Grants.gov, should allow at least 14 days to complete these requirements. It is suggested that the process be started as soon as possible.

Questions:

Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov. Part VII of this announcement explains how to submit other questions to the U.S. Department of Energy.

Application Receipt Notices

After an application is submitted, the Authorized Organization Representative (AOR) will receive a series of four e-mails. It is extremely important that the AOR watch for and save each of the emails. It may take up to two (2) business days from application submission to receipt of email Number 2. You will know that your application has reached DOE when the AOR receives email Number 4. You will need the Submission Receipt Number (email Number 1) to track a submission. The titles of the four e-mails are:

Number 1 - Grants.gov Submission Receipt Number

Number 2 - Grants.gov Submission Validation Receipt for Application Number

Number 3 - Grants.gov Grantor Agency Retrieval Receipt for Application Number

Number 4 - Grants.gov Agency Tracking Number Assignment for Application Number

After receipt of email Number 4, you can view your application at DOE's e-Center, <http://e-center.doe.gov>. A User Id and password are required. If you already have a User Id and password you do not need to re-register.

VERY IMPORTANT – Download PureEdge Viewer:

In order to download the application package, you will need to install PureEdge Viewer. This small, free program will allow you to access, complete, and submit applications electronically and securely. For a free version of the software, visit the following web site: www.grants.gov/DownloadViewer.

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PART I – FUNDING OPPORTUNITY DESCRIPTION

SUMMARY- The Office of Basic Energy Sciences (BES) of the Office of Science (SC), U.S. Department of Energy (DOE), in keeping with its mission to assist in strengthening the Nation's scientific research enterprise through the support of fundamental science and the experimental tools to perform basic research, announces its interest in receiving grant applications for basic research for the Hydrogen Fuel Initiative (HFI). Areas of focus include: Novel Materials for Hydrogen Storage; Functional Membranes; and Nanoscale Catalysts. We seek to support outstanding research programs that will lead to key discoveries to make hydrogen a feasible fuel for the future. Research funded under this initiative will pursue breakthroughs in materials, chemical and physical understandings, and interdisciplinary theory-modeling-simulation-experimentation approaches in order to surpass the existing scientific and technical barriers. More information on these focus areas is provided in the SUPPLEMENTARY INFORMATION section below.

The application must contain one paragraph addressing how the proposed research will address one or more of the four BES long-term program measures used by the Office of Management and Budget to rate the BES program annually; these measures may be found at http://www.sc.doe.gov/bes/BES_PART_Performance_Measures.pdf.

SUPPLEMENTARY INFORMATION: Since President Bush in his 2003 State of the Union address announced the Hydrogen Fuel Initiative for a clean and secure energy future, the U.S. DOE has sponsored new research to attend to the initiative goals [<http://www.science.doe.gov/bes/hydrogen.html>]. The U.S. DOE Hydrogen Program, through the participation of science and technology offices, supports both basic and applied research and development toward realizing the national hydrogen vision to produce and deliver hydrogen energy in an affordable, safe, and convenient manner. Information for applied R&D in hydrogen production, delivery, storage, fuel cell technologies, technology validation, safety, codes and standards can be found at <http://www.hydrogen.energy.gov>.

A workshop was sponsored in May 2003 by the Office of Basic Energy Sciences (OBES) to identify basic research needs for hydrogen production, storage and use. The workshop report, entitled *Basic Research Needs for the Hydrogen Economy* [<http://www.science.doe.gov/bes/hydrogen.pdf>], detailed a broad array of basic research challenges. These challenges depicted the vast gap between present-day scientific knowledge/technology capabilities and what would be required for the practical realization of a hydrogen economy. The workshop report is still a current source of information and summarizes the interests of the OBES.

In supporting the President's Hydrogen Fuel Initiative (HFI), the OBES issued its first request for proposals in 2004 under the "Basic Research for the Hydrogen Fuel Initiative," over 70 new awards were funded in 2005 and 2006 at universities and national laboratories covering the priority areas identified in the 2003 workshop report [<http://www.science.doe.gov/bes/hydrogen.html>]. This initial set of awards contributes to important areas addressing hydrogen production and storage and hydrogen utilization in fuel cells.

To tackle the challenges presented by the HFI, the basic research effort needs to be increased both in intensity and scope, particularly in regards to materials functionalities and structures,

synthesis methods, and instrumental characterization methods, as well as with regards to new theoretical methods and simulation approaches. This Notice solicits innovative basic research proposals to significantly strengthen the scientific basis that will allow comprehensive understanding of the physical and chemical processes that lead to the extraction of hydrogen from its natural environments, storage and distribution of hydrogen, and the efficient energy conversion, all in a safe as well as economically and environmentally sustainable manner. We seek to support outstanding fundamental research programs potentially leading to discoveries and breakthroughs, focused on primarily three broad areas:

- 1. Novel Materials for Hydrogen Storage**
- 2. Functional Membranes**
- 3. Nanoscale Catalysts**

The following provides further information under each of the three focus areas to illustrate the scope of proposals solicited under this Notice.

Novel Materials for Hydrogen Storage

On-board hydrogen storage is considered to be one of the most challenging barriers to the widespread use of hydrogen because the performance of current hydrogen storage materials and technologies falls far short of vehicle requirements. Hydrogen storage is also needed for off-board uses such as for stationary power generation and for hydrogen delivery and refueling infrastructure. Enormous improvements in hydrogen storage capacity and in hydrogen uptake and release kinetics and cycling durability are needed to meet the storage demands for a future hydrogen economy. Incremental improvements in current technologies will not be sufficient to meet the stated practical goals (see for example, <http://www.eere.energy.gov/hydrogenandfuelcells/mypp/>). As indicated in the BES hydrogen workshop report, basic research is essential for identifying novel materials and processes that can provide the breakthroughs needed to meet the HFI goals. These breakthroughs may result from research at the nanoscale facilitated by new understanding derived from both theory and experiment. The advances may not necessarily come from within the boundaries of metal hydrides, chemical hydrides or carbon-based materials; instead, success may well be found at the interfaces of these classes of materials or may come from "outside-the-box" concepts. Innovative basic research in the following high priority areas is needed:

- ***Novel materials.*** Research is needed to develop and examine new materials and obtain an atomic- and molecular-level understanding of the physical and chemical processes involved in hydrogen storage and release. These novel storage materials may fall outside of the hydrogen-storage materials that are currently under investigation. The innovative design and synthesis of tailored materials with high storage capacity as well as fast release times will need (a) reliable information about the structure, thermodynamic, physical, and chemical properties of novel storage materials and (b) an understanding of the interaction of hydrogen in solid-state materials.
- ***Complex hydrides.*** A basic understanding of the structure, physical, chemical, and mechanical properties of metal hydrides and complex chemical hydrides is still needed. Specifically, the fundamental factors that control bond strength, atomic processes associated with hydrogen uptake and release kinetics, the role of surface structure and chemistry in affecting hydrogen-material interactions, hydrogen-promoted mass

transport, degradation due to cycling, reversibility in metal hydrides, and regeneration of chemical hydrides must be understood. Innovative synthesis and processing routes need to be developed. The effect of dopants in achieving reasonable kinetics and reversibility needs to be understood at the atomic level.

- ***Nanostructured materials.*** Nanophase materials offer promise for superior hydrogen storage due to short diffusion distances, new phases with better capacity, reduced heats of adsorption/desorption, faster kinetics, and surface states capable of catalyzing hydrogen dissociation. Improved bonding and kinetic properties may permit good reversibility at lower desorption temperatures. Tailored nanostructures based on light metal hydrides, carbon-based nano-materials, and other non-traditional storage approaches need to be explored with the focus on understanding the unique surfaces and interfaces of nanostructured materials and how they affect the energetics, kinetics, and thermodynamics of hydrogen storage.
- ***Theory, modeling, and simulation.*** Theory, modeling, and simulation will enable (1) understanding the physics and chemistry of hydrogen interactions at the appropriate size scale and (2) the ability to simulate, predict, and design materials performance. Examples of research areas include: hydrogen interactions with surface, interface, grain boundaries and bulk defects of a particular storage material. The emphasis will be to establish the fundamental understanding of hydrogen-materials interactions so that completely new and revolutionary hydrogen storage media can be identified and designed.
- ***Novel analytical and characterization tools.*** Sophisticated analytical and characterization techniques are needed to meet the high sensitivity requirements associated with characterizing hydrogen-materials interactions, especially for nanostructured materials, while maintaining high specificity in characterization. The structure and surface properties of high-performance nanomaterials need to be identified to facilitate the modeling and provide an understanding of structure-property relationship. In-situ studies are needed to characterize site-specific hydrogen adsorption and release processes at the molecular level.

Functional Membranes

Novel membranes optimized with respect to ionic conductivity, thermal stability, cost, and durability are needed to significantly improve the performance of fuel cell systems for hydrogen energy conversion. A detailed understanding of interactions between chemical species and membranes, or among species confined within membranes, is needed to develop new separation processes. The molecular design and synthesis of new membranes to selectively transport hydrogen, oxygen and other species is vital to the purification of fuel streams, transport of species between electrodes, and separation of hydrogen in electrochemical, photochemical, or thermochemical production routes. Often these membrane functions are closely coupled with catalytic functions such as dissociation, ionization, or oxidation/reduction. Often they must function in water environment at temperatures below the boiling point of water. These membranes may lack selectivity to prevent cross-over between electrodes or to separate selected species efficiently. Currently available oxide membranes, which are critical for ionic transport in higher-temperature fuel cells, are also inefficient. For all types of membranes, the fundamental physical and chemical processes that determine transport and separation efficiency need better understanding. Overcoming the barriers described above will require an integrated, basic

research effort to enable discovery of new membrane materials, improvement in membrane performance, and integration of membrane and catalytic functions. The following are some of the high priority research directions.

- ***Integrated nanoscale architectures.*** The nanoscale dimensions of catalyst particles, support materials, and ion-conducting membranes make it possible to design compact structures that facilitate transport of ions, electrons, and gases. Self-assembly or other approaches to synthesize integrated structures pose significant technical challenges but have the potential to improve catalyst uniformity and perhaps enhance endurance and overall performance. Synthesis and characterization of radically new nanoscale and porous materials are required, including but not restricted to microporous oxides, metal-organic frameworks, bioinspired structures, carbons that remove sulfur and carbon monoxide from hydrogen, etc. New approaches to the design and fabrication of integrated nanoscale architectures may enable ultra-pure hydrogen to be produced from fossil, solar, thermochemical and bioinspired processes.
- ***Fuel cell membranes.*** Novel membranes with higher ionic conductivity, better mechanical strength, lower cost, and longer life are critical to the success of fuel cell technologies and other technologies that depend on ionic transport. Polymeric membranes that conduct protons and remain hydrated up to high temperatures are needed. Membranes that do not even require hydration yet meet the conductivity, durability and cost requirements are also desired. Novel oxide-ion membranes that operate at lower temperatures while maintaining selectivity and permeability, as well as membranes that are stable and durable under harshly corrosive environments are needed for efficient thermal cycles. Achieving these goals will require discovery of novel materials, as well as better understanding and control of the electrochemical processes at the electrodes and membrane electrolyte interfaces.
- ***Theory, modeling, and simulation of membranes and fuel cells.*** Fundamental understanding of the selective transport of molecules, atoms, and ions in polymeric as well as oxide membranes is emerging. The diversity of transport mechanisms and their dependence on structure over a wide temperature range requires extensive theory, modeling and simulation to discover the basic principles and develop design strategies for improved membrane performance. Significant emphasis is placed on understanding the nature of proton transport in membranes; the interaction of complex aqueous, gaseous, and solid interfaces in gas diffusion electrode assemblies; the nature of corrosion processes under applied electrochemical potentials and in oxidative media; and the origin of the performance-robbing overpotential for fuel cell cathodes.
- ***Characterization of electrochemical and buried interfaces.*** Innovative techniques are needed to study the microstructure and reactivity of buried interfaces under chemical or electrical potentials. This is relevant to such applications as electrocatalyst/electrolyte interfaces in membrane-electrode assemblies, or membrane-ceramic interfaces in separation media. Understanding and controlling the structure and morphology of the membranes and their evolution during operation is crucial to maximizing performance. Therefore, *in-situ* characterization methods become particularly important.

Nanoscale Catalysts

Catalysis impacts many of the technologies for which breakthroughs are needed, ranging from production of hydrogen from traditional sources such as oil and gas, as well as underexploited sources such as coal, biomass, and water, to the low-activation-energy storage or removal of hydrogen, and to the production of electricity from fuel cells or photocells. Catalysts in many cases make possible hydrogen-related transformations that are unfeasible or impractical otherwise, by providing new reaction pathways. In other cases, catalysts increase the efficiency of hydrogen-related processes such as production, uptake and release of stored hydrogen by reduction of the energy of thermal activation. Breakthroughs in catalytic research would impact the thermodynamic efficiency of hydrogen production, storage, and use, and thus improve the economic efficiency with which the primary energy sources - fossil, biomass, solar, or nuclear - serve our energy needs. Most fuel-cell and low-temperature reforming catalysts or low-temperature combustion catalysts are based on noble metals. From a fundamental point of view, it is of interest to expand our understanding and use of non-noble metals in fuel cells, reforming and other processes. The following are some of the high-priority research directions.

- ***Synthesis-structure-function relationships of nanoscale catalysts.*** The control of chemical selectivity and activity is the key to the discovery of new or more efficient hydrogen-related activation and conversion pathways. The selectivity and activity properties that arise with matter at nanometer dimensions are mostly unknown or need to be better understood. The relationship between the electronic structure of the catalyst or electrocatalyst and the support, and the catalytic activity needs to be better known. Thus, single-site catalysts with predictable chemical functionalities need to be developed. The chemical conversion of hydrogen-containing molecules with well-defined and stable clusters of metals, oxides and other compounds needs to be understood. Such need for deeper understanding is particularly crucial for catalysts based on non-noble metals.
- ***Structural dynamics of catalysts.*** It is desirable to synthesize and operate catalysts with predictable structures and compositions under reaction conditions. Catalytic structure, particularly at the atomic and electronic levels, is dynamic, and current catalyst design activities must be advanced beyond the static configurations of atomic and electronic structures. Structural changes at surfaces and interfaces are particularly of interest in addition to changing crystal phases, agglomeration, dissolution and reprecipitation. Such research should unravel the many chemical and physical events that influence catalytic behavior. It is of interest to consider fast transients, for example cationic or anionic segregation that occurs during redox cycles and leads to the formation and re-annealing of defect planes, or metal surface diffusion that is driven by chemical, thermal or electric gradients and leads to restructuring. It is also of interest to consider slow transient phenomena, for example nanoparticle sintering in electrodes, solid phase separation in mixed oxides, polymerization and phase separation of oxide species on surfaces, solid state reactions and deactivation or promotion, etc.
- ***Dynamic behavior of catalytic reactions.*** Catalytic reactions of oxygen- or hydrogen-containing molecules proceed with mechanisms that can be described with classical kinetics or microkinetics models, which primarily explain the statistical behavior of reacting species. It is of interest, however, to uncover the dynamics of single events, such

as bond formation and scission on surfaces or at single sites, or elemental transfer between adsorbed species, or energy transfer between reactants, products, catalytic sites and outgoing or incoming electrons, etc., by means of advanced experiments and theory. At the longer timescales corresponding to a full catalytic turnover, it is of interest to understand how macroscopic mechanisms or statistical molecular behavior correlate with the catalytic structural dynamics described in the previous bullet.

- ***Innovative synthesis techniques.*** A basic challenge for catalysis in hydrogen production, storage and fuel cells is the synthesis of well-defined catalysts. Approaches are needed to tailor the molecular precursors and building blocks to yield stable quasi-equilibrium structures that retain excellent catalytic performance and robustness at extreme conditions of temperature, pressure, and potential cycling while exposed to the reaction medium. Synthesis with atomic-scale precision is necessary to produce tailored structures of catalysts on supports with controlled size, shape and surface characteristics. New, high-throughput innovative synthesis methods must be combined with theory and advanced measurement capabilities to accelerate the development of designed catalysts. In addition, novel, cost-effective fabrication methods need to be developed for the practical application of these new designer catalysts.
- ***Bio-inspired catalysts.*** A fundamental understanding is needed of bio-inspired complexes that are able to perform activation of hydrogen-containing molecules. New opportunities for hydrogen reactions are sought from the discovery of synthetic analogues that operate at the high potential required for water oxidation and are able to perform a four-electron reduction, or proton-coupled redox reactions, and avoid the production of corrosive intermediates. In analogy to natural systems, bio-inspired catalysts should be able to self-repair and provide robust resilience to defects.
- ***Techniques for in-situ characterization under reaction.*** Fundamental understanding of complex catalytic mechanisms in hydrogen processes requires identification of the nature of the active sites under actual reaction conditions; the interaction of the reactants, intermediates and products with the active sites; detection of intermediate species; and quantification of the dynamics of atomic, electronic and energetic exchanges. There is a special need for ultrafast and high-resolution imaging and spectroscopic techniques to determine the interatomic arrangements, interactions and transformations in model catalysts during reaction. Such methods, in combination with advances in theory and simulation, should lead to fundamental understanding of catalytic mechanisms.
- ***Theory, modeling, and simulation of catalytic pathways.*** This initiative seeks to support innovative methods to produce predictive models of catalytic reactivity relevant to hydrogen energy processes. Theoretical methods have now been developed to the point that entire reaction pathways and reactivity trends can be predicted and understood. Close coupling between experimental observations and theory, modeling, and simulation will provide unprecedented capabilities to design more selective, robust, and defect-tolerant catalysts for hydrogen production, storage, and fuel cells. This approach will enable the design and control of the chemical and physical properties of the catalyst, its supporting structure, and the associated molecular processes at the nano-, meso- and macroscopic scales.

Solar-energy related research, specifically solar production of hydrogen and photocatalytic formation of fuels, is covered under a separate notice. Please see the Office of Science Financial

Assistance Program Notice DE-PS02-06ER06-15, Basic Research for Solar Energy Utilization, <http://www.science.doe.gov/grants/FAPN06-15.html>.

Coordination and Integration with the DOE Offices of Energy Efficiency and Renewable Energy (EERE), Fossil Energy (FE), and Nuclear Energy Science and Technology (NE) Hydrogen Program

The proposal solicitation and selection processes will be coordinated with EERE, FE, and NE's program to ensure successful integration of the basic research components with the applied technology program. Specifically, input from EERE, FE and NE have been incorporated in the formulation of this announcement, and further input will be solicited in the review of preproposals. There will also be an annual Contractors' Meeting for all participants in the BES program to help coordinate and integrate research efforts related to hydrogen research. The Annual Contractors' Meeting of BES principal investigators will be coordinated with EERE, FE and NE, and will include presentations on applied research and development needs from researchers inside and outside of the Contractors' group. Travel funds to attend this meeting must be appropriately budgeted.

PART II – AWARD INFORMATION

A. TYPE OF AWARD INSTRUMENT.

DOE anticipates awarding grants under this program announcement.

B. ESTIMATED FUNDING.

It is anticipated that up to \$12 million annually starting in Fiscal Year 2007 (subject to appropriations) will be available for multiple awards for this notice. Applications may request project support for up to three years. All awards are contingent on the availability of funds and programmatic needs.

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C. MAXIMUM AND MINIMUM AWARD SIZE.

Ceiling (i.e., the maximum amount for an individual award made under this announcement):
None

Floor (i.e., the minimum amount for an individual award made under this announcement): None

D. EXPECTED NUMBER OF AWARDS.

The number of awards will be contingent on satisfactory peer review, the availability of appropriated funds and the size of the awards.

E. ANTICIPATED AWARD SIZE.

N/A

F. PERIOD OF PERFORMANCE.

N/A

G. TYPE OF APPLICATION.

N/A

PART III - ELIGIBILITY INFORMATION

A. ELIGIBLE APPLICANTS.

All types of applicants are eligible to apply, except other Federal agencies, Federally Funded Research and Development Center (FFRDC) Contractors, and nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995.

Researchers from Federally Funded Research and Development Centers (FFRDCs) or DOE National Laboratories should respond to Program Announcement LAB 06-17, available at the following web address: http://www.science.doe.gov/grants/LAB06_17.html.

B. COST SHARING

Cost sharing is not required.

C. OTHER ELIGIBILITY REQUIREMENTS.

N/A

PART IV – APPLICATION AND SUBMISSION INFORMATION

A. ADDRESS TO REQUEST APPLICATION PACKAGE.

Application forms and instructions are available at Grants.gov. To access these materials, go to <http://www.grants.gov>, select "Apply for Grants", and then select "Download Application Package". Enter the CFDA and/or the funding opportunity number located on the cover of this announcement and then follow the prompts to download the application package. NOTE: You will not be able to download the Application Package unless you have installed PureEdge Viewer (See: <http://www.grants.gov/DownloadViewer>).

B. LETTER OF INTENT AND PREAPPLICATION.

1. Letter-of-Intent.

Letters-of-Intent are not required.

2. Preapplication.

Potential applicants are required to submit a brief preapplication containing the information specified later in this solicitation. Preapplications referencing Program Solicitation DE-PS02-06ER06-17, must be received by DOE by 4:30 p.m., Eastern Time, **July 6, 2006**.

Preapplications will be reviewed for conformance with the guidelines presented in this solicitation and suitability in the technical areas specified in this solicitation. A response to the preapplications encouraging or discouraging formal applications will be communicated to the applicants by **September 12, 2006**.

Preapplication Review and Criteria

The preapplication should consist of a description of the research proposed to be undertaken by the applicant and a clear explanation of its importance to the advancement of basic hydrogen research and its relevance to the HFI. The preapplication must be submitted electronically to hydrogen@science.doe.gov as two files:

(1) A cover page in Excel format downloadable from:

http://www.science.doe.gov/bes/hydrogen_preapp_cover.xls. The information to be entered on the cover page worksheet includes: Program Announcement Number; Lead Principal Investigator name, address, email address, telephone number, and fax number; project title; selection of one submission category (see below); budget request for each project year; and total budget request for the project. On the worksheet named coPIs enter the names and institutions of all co-Principal Investigators and/or senior collaborators (excluding postdocs and graduate students). Please do not alter the overall format of the cover- page Excel file, i.e., do not move or merge cells, as this will significantly slow the processing of the preproposal.

(2) A PDF file containing a narrative section not to exceed 3 pages (including text and figures) describing the research objectives, approaches to be taken, the institutional setting, and a description of any research partnership if applicable. In addition, include brief, one-page, curriculum vitae from each Principal Investigator.

As noted above, the preapplication must also identify the primary submission topic: (1) Novel Materials for Hydrogen Storage; or (2) Functional Membranes; or (3) Nanoscale Catalysts. The purpose of this self-identification into a research topic is solely for the purposes of grouping similar proposals for peer review.

C. CONTENT AND FORM OF APPLICATION – SF 424 (R&R)

You must complete the mandatory forms and any applicable optional forms (e.g., SF-LLL-Disclosure of Lobbying Activities) in accordance with the instructions on the forms and the additional instructions below. **Files that are attached to the forms must be in Adobe Portable Document Format (PDF) unless otherwise specified in this announcement.**

1. SF 424 (R&R)

Complete this form first to populate data in other forms. Complete all the required fields in accordance with the pop-up instructions on the form. To activate the instructions, turn on the “Help Mode” (Icon with the pointer and question mark at the top of the form). The list of certifications and assurances referenced in Field 18 can be found on the Applicant and Recipient Page at <http://grants.pr.doe.gov>.

2. RESEARCH AND RELATED Other Project Information.

Complete questions 1 through 5 and attach files. The files must comply with the following instructions:

Project Summary/Abstract (Field 6 on the Form)

The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to publication. It should be a single page that identifies the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (i.e., benefits, outcomes), and major participants (for collaborative projects). This document must not include any proprietary or sensitive business information as the Department may make it available to the public. The project summary must not exceed 1 page when printed using standard 8.5” by 11” paper with 1” margins (top, bottom, left and right) with font not smaller than 11 point. To attach a Project Summary/Abstract, click “Add Attachment.”

Project Narrative (Field 7 on the form)

The project narrative must not exceed 20 pages, including charts, graphs, maps, photographs, and other pictorial presentations, when printed using standard 8.5” by 11” paper with 1 inch margins (top, bottom, left, and right). The font must not be smaller than 11 point. Do not include any Internet addresses (URLs) that provide information necessary to review the application, because the information contained in these sites will not be reviewed. **All applications should be in a single PDF file.** To attach a Project Narrative, click “Add Attachment.”

The Research & Related Other Project Information form of the Grants.gov template should be completed in the following manner. **Project Narrative is Field 7 on the form.** The first page of your narrative must include the following information:

Applicant/Institution:

Street Address/City/State/Zip:

Principal Investigator:

Address:

Telephone Number:

Email:

Contaminant(s) of Interest:

DOE/Office of Science Program Office:

DOE/Office of Science Program Office Technical Contact:

DOE Grant Number (if Renewal or Supplemental Application):

Is this a Collaboration? If yes, please list ALL Collaborating Institutions/PIs and indicate which ones will also be submitting applications. Also indicate the PI who will be the point of contact and coordinator for the combined research activity.

Relevance Statement; one paragraph, **all applications submitted in response to this Solicitation must explicitly state how the proposed research will address one or more of the four BES long-term program measures used by the Office of Management and Budget to rate the BES program annually; these measures may be found at http://www.sc.doe.gov/bes/BES_PART_Performance_Measures.pdf**

Project Narrative, 20 pages or less, exclusive of attachments. Applications with Project Narratives longer than 20 pages will be returned to applicants and will not be reviewed for scientific merit. The project narrative should be a clear statement of the work to be undertaken and should include: objectives for the period of the proposed work and expected significance; relation to the longer-term goals of the principal investigator of the project; and relation to the present state of knowledge in the field, to work in progress by the investigator under other support, and work in progress elsewhere. The statement should outline the general plan of work, including the broad design of experiments to be undertaken, and an adequate description of experimental methods and procedures. Attachments should include short (2 pages) curriculum vitae, QA/QC plan, a listing of all current and pending federal support and Letters of Intent for proposed collaborators (when applicable).

Biographical Sketches

Current and Pending Support for each senior investigator

Letters of Intent from collaborators (if applicable)

Facilities and Resources description

Literature Cited

The project narrative must include: **(and any other items as listed in the Funding Opportunity Description above)**

- Project Objectives.
This section should provide a clear, concise statement of the specific objectives/aims of the proposed project.
- Evaluation Phase
This section must include a plan and metrics to be used to assess the success of the project.
- Project Performance Site
Indicate the primary site where the work will be performed. If a portion of the work will be performed at any other sites, identify those sites, also.
- Biographical Sketch Appendix
Provide a biographical sketch for the project director/principal investigator (PD/PI) and each senior/key person listed in Section A on the R&R Budget form. **Provide the biographical sketch information as an appendix to your project narrative. Do not attach a separate file.** The biographical sketch appendix will not count in the project narrative page limitation. The biographical information for each person must not exceed 2 pages when printed on 8.5" by 11" paper with 1 inch margins (top, bottom, left, and right) with font not smaller than 11 point and must include:

Education and Training. Undergraduate, graduate and postdoctoral training, provide institution, major/area, degree and year.

Research and Professional Experience: Beginning with the current position list, in chronological order, professional/academic positions with a brief description.

Publications. Provide a list of up to 10 publications most closely related to the proposed project. For each publication, identify the names of all authors (in the same sequence in which they appear in the publication), the article title, book or journal title, volume number, page numbers, year of publication, and website address if available electronically.

Patents, copyrights and software systems developed may be provided in addition to or substituted for publications.

Synergistic Activities. List no more than 5 professional and scholarly activities related to the effort proposed.

- Identification of Potential Conflicts of Interest or Bias in Selection of Reviewers. Provide the following information in this section:

Collaborators and Co-editors: List in alphabetical order all persons, including their current organizational affiliation, who are, or who have been,

collaborators or co-authors with you on a research project, book or book article, report, abstract, or paper during the 48 months preceding the submission of this application. Also, list any individuals who are currently, or have been, co-editors with you on a special issue of a journal, compendium, or conference proceedings during the 24 months preceding the submission of this application. If there are no collaborators or co-editors to report, state "None."

Graduate and Postdoctoral Advisors and Advisees: List the names and current organizational affiliations of your graduate advisor(s) and principal postdoctoral sponsor(s) during the last 5 years. Also, list the names and current organizational affiliations of your graduate students and postdoctoral associates during the past 5 years.

- Current and Pending Support.

Provide a list of all current and pending support (both Federal and non-Federal) for the Project Director/Principal Investigator(s) (PD/PI) and senior/key persons, including subawardees, for ongoing projects and pending applications. For each organization providing support, show the total award amount for the entire award period (including indirect costs) and the number of person-months per year to be devoted to the project by the senior/key person. Concurrent submission of an application to other organizations for simultaneous consideration will not prejudice its review.

Bibliography & References Cited (Field 8 on the form)

Provide a bibliography of any references cited in the Project Narrative. Each reference must include the names of all authors (in the same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication. Include only bibliographic citations. Applicants should be especially careful to follow scholarly practices in providing citations for source materials relied upon when preparing any section of the application. **In order to reduce the number of files attached to your application, please provide the Bibliography and References Cited information as an appendix to your project narrative. Do not attach a file in field 8.** This appendix will not count in the project narrative page limitation.

Facilities & Other Resources (Field 9 on the form)

This information is used to assess the capability of the organizational resources, including subawardee resources, available to perform the effort proposed. Identify the facilities to be used (Laboratory, Animal, Computer, Office, Clinical and Other). If appropriate, indicate their capacities, pertinent capabilities, relative proximity, and extent of availability to the project. Describe only those resources that are directly applicable to the proposed work. Describe other resources available to the project (e.g., machine shop, electronic shop) and the extent to which they would be available to the project. **In order to reduce the number of files attached to your application, please provide the Facility and Other Resource information as an**

appendix to your project narrative. Do not attach a file in field 9. This appendix will not count in the project narrative page limitation.

Equipment (Field 10 on the form)

List major items of equipment already available for this project and, if appropriate identify location and pertinent capabilities. **In order to reduce the number of files attached to your application, please provide the Equipment information as an appendix to your project narrative. Do not attach a file in field 10.** This appendix will not count in the project narrative page limitation.

Other Attachment (Field 11 on the form)

If you need to elaborate on your responses to questions 1-5 on the “Other Project Information” document, **provide the information as an appendix to your project narrative. Do not attach a file in field 11.**

3. RESEARCH AND RELATED BUDGET.

Complete the Research and Related Budget form in accordance with the instructions on the form (Activate Help Mode to see instructions) and the following instructions. You must complete a separate budget for each year of support requested. The form will generate a cumulative budget for the total project period. You must complete all the mandatory information on the form before the NEXT PERIOD button is activated. You may request funds under any of the categories listed as long as the item and amount are necessary to perform the proposed work, meet all the criteria for allowability under the applicable Federal cost principles, and are not prohibited by the funding restrictions in this announcement (See PART IV, G).

Budget Justification (Field K on the form).

Provide the required supporting information for the following costs (See R&R Budget instructions): equipment; domestic and foreign travel; participant/trainees; material and supplies; publication; consultant services; ADP/computer services; subaward/consortium/contractual; equipment or facility rental/user fees; alterations and renovations; and indirect cost type. Provide any other information you wish to submit to justify your budget request. If cost sharing is required, provide an explanation of the source, nature, amount and availability of any proposed cost sharing. Attach a single budget justification file for the entire project period in Field K. The file automatically carries over to each budget year.

4. R&R SUBAWARD BUDGET ATTACHMENT(S) FORM.

Budgets for Subawardees, other than DOE FFRDC Contractors. You must provide a separate cumulative R&R budget for each subawardee that is expected to perform work estimated to be more than \$100,000 or 50 percent of the total work effort (whichever is less). If you are selected for award, you must submit a multi-year budget for each of these subawardee (See Section IV.D for submission of Subawardees’ multi-year budgets). Download the R&R Budget Attachment from the R&R SUBAWARD BUDGET ATTACHMENT(S) FORM and e-mail it to each subawardee that is required to submit a separate budget. Note: Subwardees must have installed PureEdge Viewer before they can

complete the form. After the Subawardee has e-mailed its completed budget back to you, attach it to one of the blocks provided on the form. Use up to 10 letters of the subawardee's name (plus .xfd) as the file name (e.g., ucla.xfd or energyres.xfd).

5. SF-LLL Disclosure of Lobbying Activities

If applicable, complete SF- LLL. Applicability: If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the grant/cooperative agreement, you must complete and submit Standard Form - LLL, "Disclosure Form to Report Lobbying."

D. SUBMISSIONS FROM SUCCESSFUL APPLICANTS.

The Department anticipates that no additional submissions will be required. However, it reserves the right to request additional or clarifying information for any reason deemed necessary.

E. SUBMISSION DATES AND TIMES.

1. Preapplication Due Date.

Potential applicants are required to submit a brief preapplication containing the information specified in this solicitation. Preapplications referencing Program Solicitation DE-PS02-06ER06-17, must be received by DOE by 4:30 p.m., Eastern Time, **July 6, 2006**.

Preapplications will be reviewed for conformance with the guidelines presented in this solicitation and suitability in the technical areas specified in this solicitation. A response to the preapplications encouraging or discouraging formal applications will be communicated to the applicants by **September 12, 2006**.

Preapplication Review and Criteria

The preapplication should consist of a description of the research proposed to be undertaken by the applicant and a clear explanation of its importance to the advancement of basic hydrogen research and its relevance to the HFI. The preapplication must be submitted electronically to hydrogen@science.doe.gov as two files:

(1) A cover page in Excel format downloadable from:

http://www.science.doe.gov/bes/hydrogen_preapp_cover.xls. The information to be entered on the cover page worksheet includes: Program Announcement Number; Lead Principal Investigator name, address, email address, telephone number, and fax number; project title; selection of one submission category (see below); budget request for each project year; and total budget request for the project. On the worksheet named coPIs enter the names and institutions of all co-Principal Investigators and/or senior collaborators (excluding postdocs and graduate students). Please do not alter the overall format of the cover- page Excel file, i.e., do not move or merge cells, as this will significantly slow the processing of the preproposal.

(2) A PDF file containing a narrative section not to exceed 3 pages (including text and figures) describing the research objectives, approaches to be taken, the institutional setting, and a description of any research partnership if applicable. In addition, include brief, one-page, curriculum vitae from each Principal Investigator.

As noted above, the preapplication must also identify the primary submission topic: (1) Novel Materials for Hydrogen Storage; or (2) Functional Membranes; or (3) Nanoscale Catalysts. The purpose of this self-identification into a research topic is solely for the purposes of grouping similar proposals for peer review.

2. Application Due Date.

Only those preapplicants that receive notification from DOE encouraging a formal application may submit a full application. No other formal applications will be considered. Formal applications in response to this notice must be received by **December 12, 2006, 8:00p.m. Eastern Time**. APPLICATIONS RECEIVED AFTER THE DEADLINE WILL NOT BE REVIEWED OR CONSIDERED FOR AWARD.

F. GOVERNMENTAL REVIEW .

This program is subject to Executive Order 12372 (Intergovernmental Review of Federal Programs) and the regulations at 10 CFR Part 1005.

One of the objectives of the Executive order is to foster an intergovernmental partnership and a strengthened federalism. The Executive order relies on processes developed by State and local governments for coordination and review of proposed Federal financial assistance.

Applicants should contact the appropriate State Single Point of Contact (SPOC) to find out about, and to comply with, the State's process under Executive Order 12372. The names and addresses of the SPOCs are listed on the Web site of the Office of Management and Budget at <http://www.whitehouse.gov/omb/grants/spoc.html>.

G. FUNDING RESTRICTIONS.

Cost Principles. Costs must be allowable in accordance with the applicable Federal cost principles referenced in 10 CFR Part 600.

Pre-award Costs. Recipients may charge to an award resulting from this announcement pre-award costs that were incurred within the ninety (90) calendar day period immediately preceding the effective date of the award, if the costs are allowable in accordance with the applicable Federal cost principles referenced in 10 CFR Part 600. Recipients must obtain the prior approval of the contracting officer for any pre-award costs that are for periods greater than this 90 day calendar period.

Pre-award costs are incurred at the applicant's risk. DOE is under no obligation to reimburse such costs if for any reason the applicant does not receive an award or if the award is made for a

lesser amount than the applicant expected.

H. OTHER SUBMISSION AND REGISTRATION REQUIREMENTS

1. Where to Submit.

APPLICATIONS MUST BE SUBMITTED THROUGH GRANTS.GOV TO BE CONSIDERED FOR AWARD. Submit electronic applications through the “Apply for Grants” function at www.Grants.gov. If you have problems completing the registration process or submitting your application, call Grants.gov at 1-800-518-4726 or send an email to support@grants.gov.

2. Registration Process.

You must COMPLETE the one-time registration process (all steps) before you can submit your first application through Grants.gov (See www.grants.gov/GetStarted). **We recommend that you start this process at least two weeks before the application due date.** It may take 14 days or more to complete the entire process. Use the Grants.gov Organizational Registration Checklists at <http://www.grants.gov/assets/OrganizationRegCheck.doc> to guide you through the process. **IMPORTANT:** During the CCR registration process, you will be asked to designate an E-Business Point of Contact (EBIZ POC). The EBIZ POC must obtain a special password called “Marketing Partner identification Number” (MPIN).

Part V - APPLICATION REVIEW INFORMATION

A. CRITERIA

1. Initial Review Criteria.

Prior to a comprehensive merit evaluation, DOE will perform an initial review in accordance with 10 CFR 605.10(b).

2. Merit Review Criteria.

The review process will consist of a merit review of the application, which may include a site visit, followed by a programmatic and administrative review of applications being considered for award.

Applications will be subjected to formal merit review (peer review) and will be evaluated against the following evaluation criteria which are listed in descending order of importance codified at 10 CFR 605.10(d):

1. Scientific and/or Technical Merit of the Project;
2. Appropriateness of the Proposed Method or Approach;
3. Competency of Applicant's Personnel and Adequacy of Proposed Resources;
4. Reasonableness and Appropriateness of the Proposed Budget; and
5. Basic research that is relevant to the President's Hydrogen Fuel Initiative.

As part of the evaluation, program policy factors also become a selection priority. Note, external peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Federal and non-federal reviewers will be used, and submission of an application constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

B. REVIEW AND SELECTION PROCESS.

1. Merit Review.

Applications will be subjected to formal merit review (peer review) and will be evaluated against the evaluation criteria codified at 10 CFR 605.10(d) listed above, as well as the additional criteria listed above.

2. Selection.

The Selection Official will consider the merit review recommendation, program policy factors, and the amount of funds available.

3. Discussions and Award.

The Government may enter into discussions with a selected applicant for any reason deemed necessary, including but not limited to: (1) the budget is not appropriate or reasonable for the requirement; (2) only a portion of the application is selected for award; (3) the Government needs additional information to determine that the recipient is capable of complying with the requirements in 10 CFR part 600 and 605; and/or (4) special terms and conditions are required. Failure to resolve satisfactorily the issues identified by the Government will preclude award to the applicant.

C. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES.

DOE is striving to make awards within eight months. The time interval begins on the date applications are due or the date the application is received, if there is no specified due date/deadline.

Part VI - AWARD ADMINISTRATION INFORMATION

A. AWARD NOTICES.

1. Notice of Selection.

DOE will notify applicants selected for award. This notice of selection is not an authorization to begin performance. (See Part IV.G with respect to the allowability of pre-award costs.)

Organizations whose applications have not been selected will be advised as promptly as possible. This notice will explain why the application was not selected.

2. Notice of Award.

A Notice of Financial Assistance Award issued by the contracting officer is the authorizing award document. It normally includes, either as an attachment or by reference: 1. Special Terms and Conditions; 2. Applicable program regulations, if any; 3. Application as approved by DOE; 4. DOE assistance regulations at 10 CFR Part 600, or, for Federal Demonstration Partnership (FDP) institutions, the FDP terms and conditions; 5. National Policy Assurances to Be Incorporated As Award Terms; 6. Budget Summary; and 7. Federal Assistance Reporting Checklist, which identifies the reporting requirements.

B. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS.

1. Administrative Requirements.

The administrative requirements for DOE grants and cooperative agreements are contained in 10 CFR Part 600 and 10 CFR Part 605 (See: <http://ecfr.gpoaccess.gov>), except for grants made to Federal Demonstration Partnership (FDP) institutions. The FDP terms and conditions and DOE FDP agency specific terms and conditions are located on the National Science Foundation web site at http://www.nsf.gov/awards/managing/fed_dem_part.jsp.

2. Special Terms and Conditions and National Policy Requirements.

Special Terms and Conditions and National Policy Requirements.

The DOE Special Terms and Conditions for Use in Most Grants and Cooperative Agreements are located at <http://grants.pr.doe.gov>. The National Policy Assurances To Be Incorporated As Award Terms are located at <http://grants.pr.doe.gov>.

Intellectual Property Provisions.

The standard DOE financial assistance intellectual property provisions applicable to the various types of recipients are located at http://www.gc.doe.gov/techtrans/sipp_matrix.html.

C. REPORTING.

Reporting requirements are identified on the Federal Assistance Reporting Checklist, DOE F4600.2, attached to the award agreement.

PART VII - QUESTIONS/AGENCY CONTACTS

A. QUESTIONS

Questions regarding the content of the announcement must be submitted through the “Submit Question” feature of the DOE Industry Interactive Procurement System (IIPS) at <http://e-center.doe.gov>. Locate the program announcement on IIPS and then click on the “Submit Question” button. Enter required information. You will receive an electronic notification that your question has been answered. DOE will try to respond to a question within 3 business days, unless a similar question and answer have already been posted on the website.

Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov. DOE cannot answer these questions.

Questions regarding the program (**technical**) requirements should be directed to:

Agency Contacts:

For specific information on DOE interests, contact:

Dr. Raul Miranda
Chemical Sciences, Geosciences, and Biosciences Division
SC-22.12/Germantown Building
Office of Basic Energy Sciences
Office of Science
U.S. Department of Energy
1000 Independence Ave., SW
Washington, D.C. 20585-1290
Telephone: (301) 903-8014
E-mail: Raul.Miranda@science.doe.gov

Or

Dr. Jane Zhu
Materials Sciences and Engineering Division
SC-22.21/Germantown Building
Office of Basic Energy Sciences
Office of Science
U.S. Department of Energy
1000 Independence Ave., SW
Washington, D.C. 20585-1290
Telephone: (301) 903-3811
E-mail: Jane.Zhu@science.doe.gov

PART VIII - OTHER INFORMATION

A. MODIFICATIONS.

Notices of any modifications to this announcement will be posted on Grants.gov and the DOE Industry Interactive Procurement System (IIPS). You can receive an email when a modification or an announcement message is posted by joining the mailing list for this announcement through the link in IIPS. When you download the application at Grants.gov, you can also register to receive notifications of changes through Grants.gov.

B. GOVERNMENT RIGHT TO REJECT OR NEGOTIATE.

DOE reserves the right, without qualification, to reject any or all applications received in response to this announcement and to select any application, in whole or in part, as a basis for negotiation and/or award.

C. COMMITMENT OF PUBLIC FUNDS.

The Contracting Officer is the only individual who can make awards or commit the Government to the expenditure of public funds. A commitment by other than the Contracting Officer, either explicit or implied, is invalid.

D. PROPRIETARY APPLICATION INFORMATION.

Patentable ideas, trade secrets, proprietary or confidential commercial or financial information, disclosure of which may harm the applicant, should be included in an application only when such information is necessary to convey an understanding of the proposed project. The use and disclosure of such data may be restricted, provided the applicant includes the following legend on the first page of the project narrative and specifies the pages of the application which are to be restricted:

“The data contained in pages _____ of this application have been submitted in confidence and contain trade secrets or proprietary information, and such data shall be used or disclosed only for evaluation purposes, provided that if this applicant receives an award as a result of or in connection with the submission of this application, DOE shall have the right to use or disclose the data herein to the extent provided in the award. This restriction does not limit the government’s right to use or disclose data obtained without restriction from any source, including the applicant.”

To protect such data, each line or paragraph on the pages containing such data must be specifically identified and marked with a legend similar to the following:

“The following contains proprietary information that (name of applicant) requests not be released to persons outside the Government, except for purposes of review and evaluation.”

E. EVALUATION AND ADMINISTRATION BY NON-FEDERAL PERSONNEL.

In conducting the merit review evaluation, the Government may seek the advice of qualified non-Federal personnel as reviewers. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The applicant, by submitting its

application, consents to the use of non-Federal reviewers/administrators. Non-Federal reviewers must sign conflict of interest and non-disclosure agreements prior to reviewing an application. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

F. INTELLECTUAL PROPERTY DEVELOPED UNDER THIS PROGRAM.

Patent Rights. The government will have certain statutory rights in an invention that is conceived or first actually reduced to practice under a DOE award. 42 U.S.C. 5908 provides that title to such inventions vests in the United States, except where 35 U.S.C. 202 provides otherwise for nonprofit organizations or small business firms. However, the Secretary of Energy may waive all or any part of the rights of the United States subject to certain conditions. (See “Notice of Right to Request Patent Waiver” in paragraph G below.)

Rights in Technical Data. Normally, the government has unlimited rights in technical data created under a DOE agreement. Delivery or third party licensing of proprietary software or data developed solely at private expense will not normally be required except as specifically negotiated in a particular agreement to satisfy DOE’s own needs or to insure the commercialization of technology developed under a DOE agreement.

G. NOTICE OF RIGHT TO REQUEST PATENT WAIVER.

Applicants may request a waiver of all or any part of the rights of the United States in inventions conceived or first actually reduced to practice in performance of an agreement as a result of this announcement, in advance of or within 30 days after the effective date of the award. Even if such advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver of the rights of the United States in identified inventions, i.e., individual inventions conceived or first actually reduced to practice in performance of the award. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.

Domestic small businesses and domestic nonprofit organizations will receive the patent rights clause at 37 CFR 401.14, i.e., the implementation of the Bayh-Dole Act. This clause permits domestic small business and domestic nonprofit organizations to retain title to subject inventions. Therefore, small businesses and nonprofit organizations do not need to request a waiver.

H. N/A

I. N/A